



VIIRS ICE PRODUCTS: SURFACE TEMPERATURE, CONCENTRATION, AND THICKNESS

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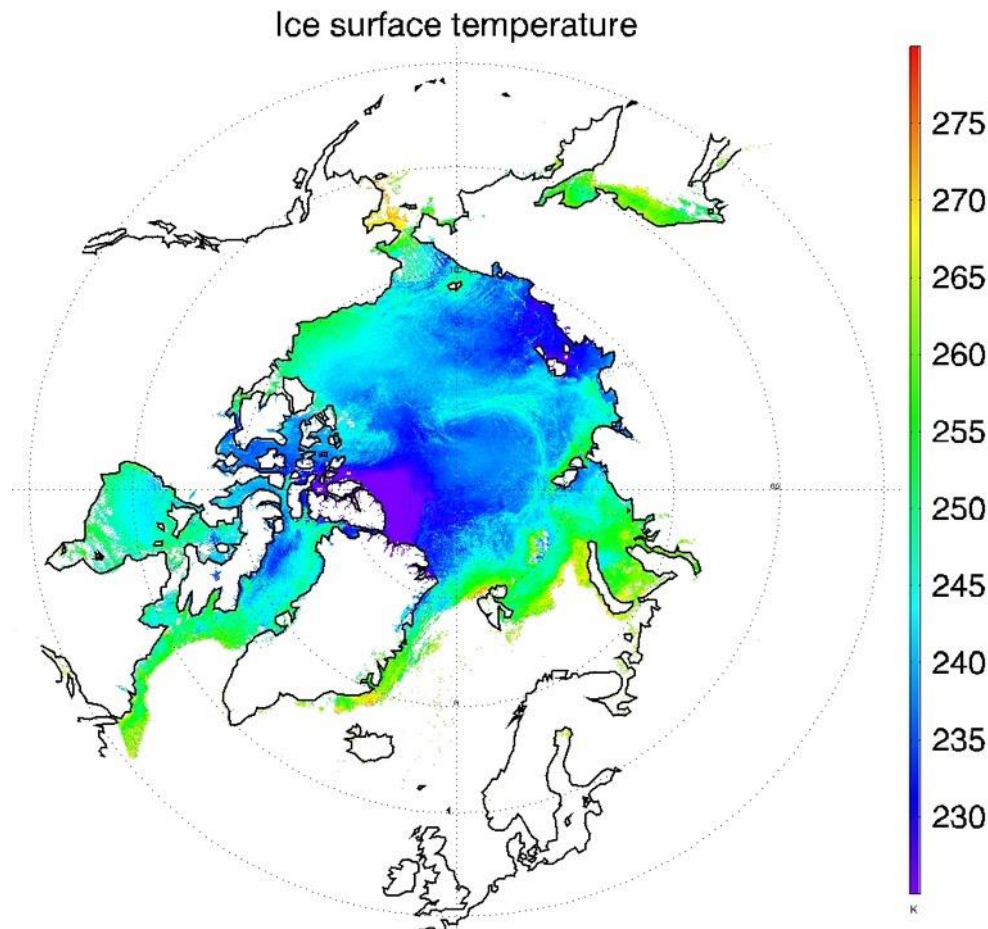
J. Key, NOAA/NESDIS

Sea Ice Cal/Val Team Members

PI	Organization	Team Members	Roles and Responsibilities
J. Key	NOAA NESDIS	M. Tschudi Y. Liu R. Dworak X. Wang A. Letterly	Ice conc & thickness cal/val IST development, cal/val IST cal/val Ice thickness development, cal/val NDE cryo products assessment

VIIRS Ice Surface Temperature

IST is the radiating, or "skin", temperature at the ice surface. It includes the aggregate temperature of objects comprising the ice surface, including snow and melt water on the ice.

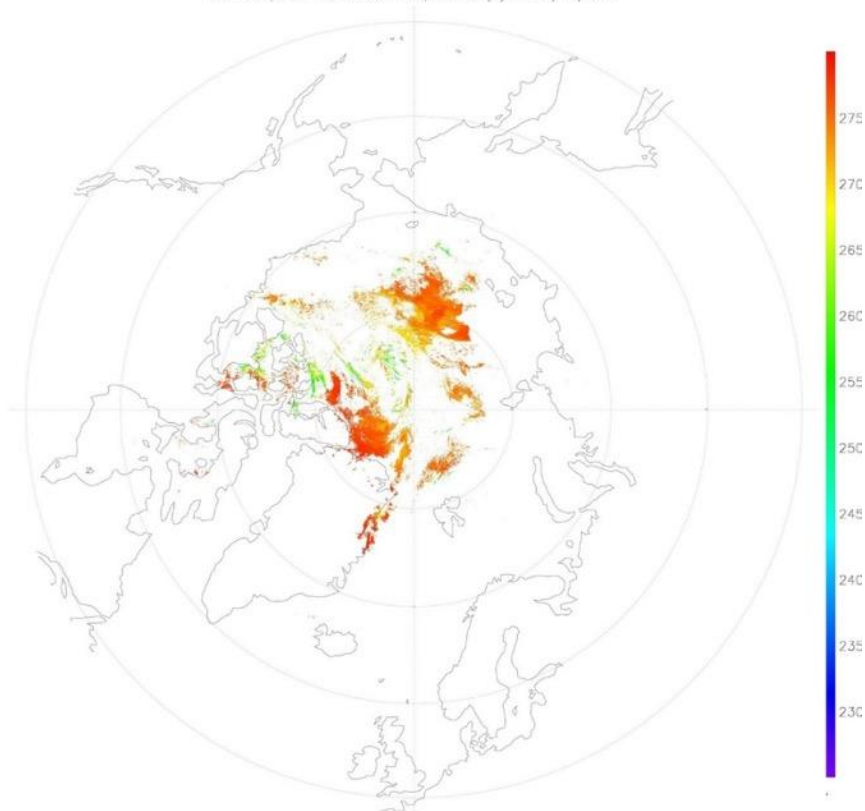


Ice surface temperature (IST) composite from all overpasses over the Arctic on March 1, 2015. From *Liu et al.*, 2015.

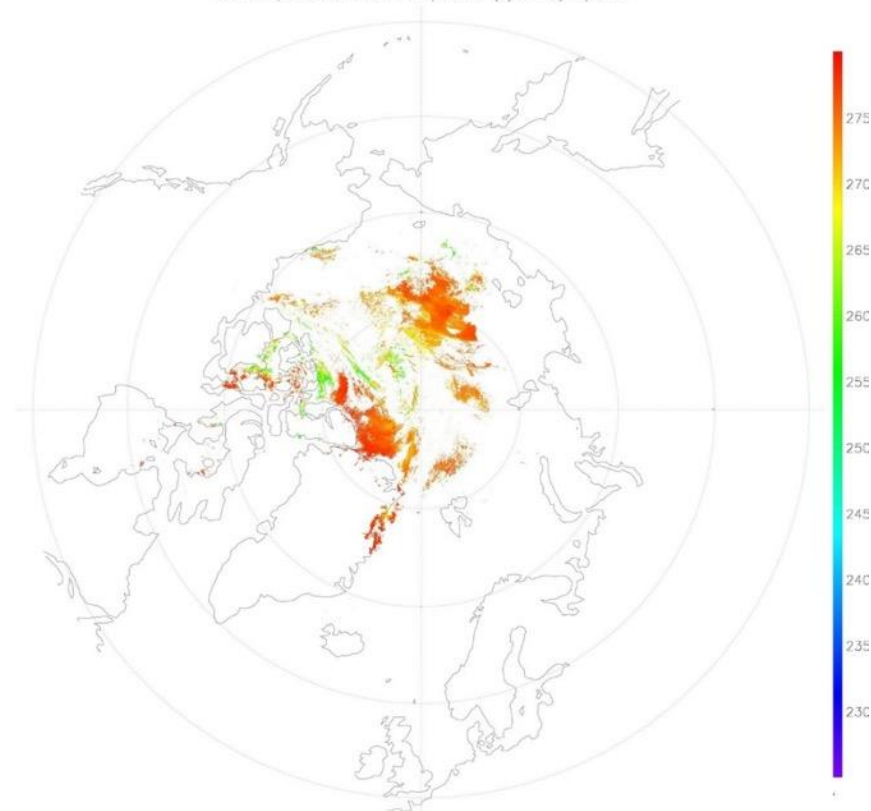
NOAA-20 and S-NPP IST, Arctic, Aug 18, 2018

(all NOAA-20 images in this presentation are generated by CIMSS)

N20_Composite Ice Surface Temperature (K) on 08/18/2018

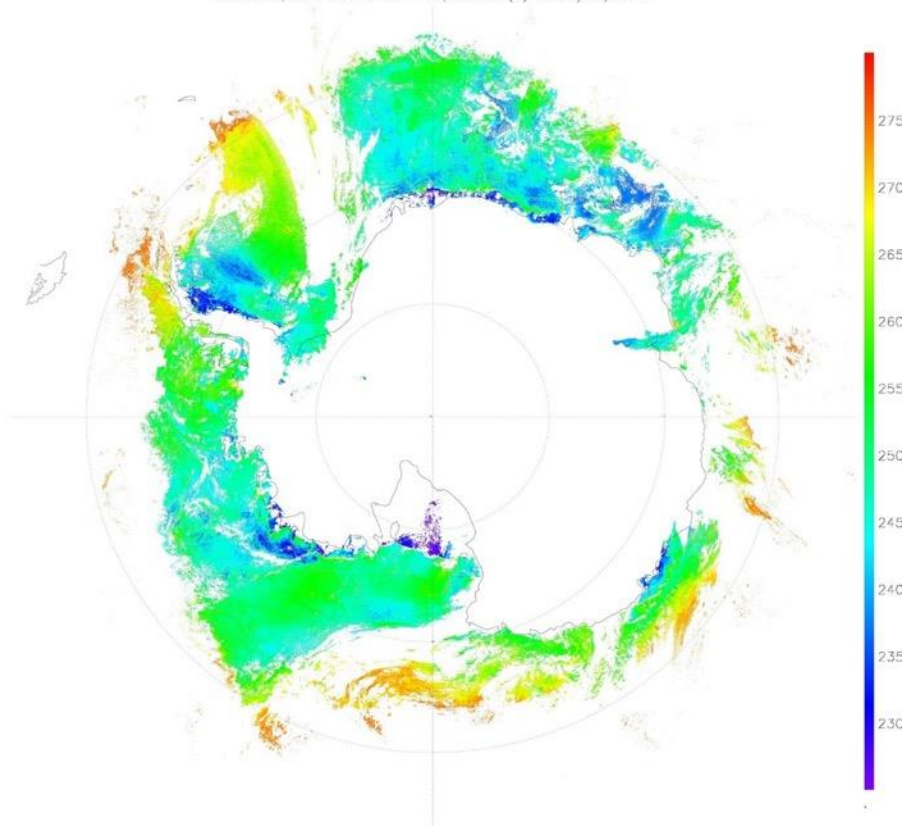


NPP_Composite Ice Surface Temperature (K) on 08/18/2018

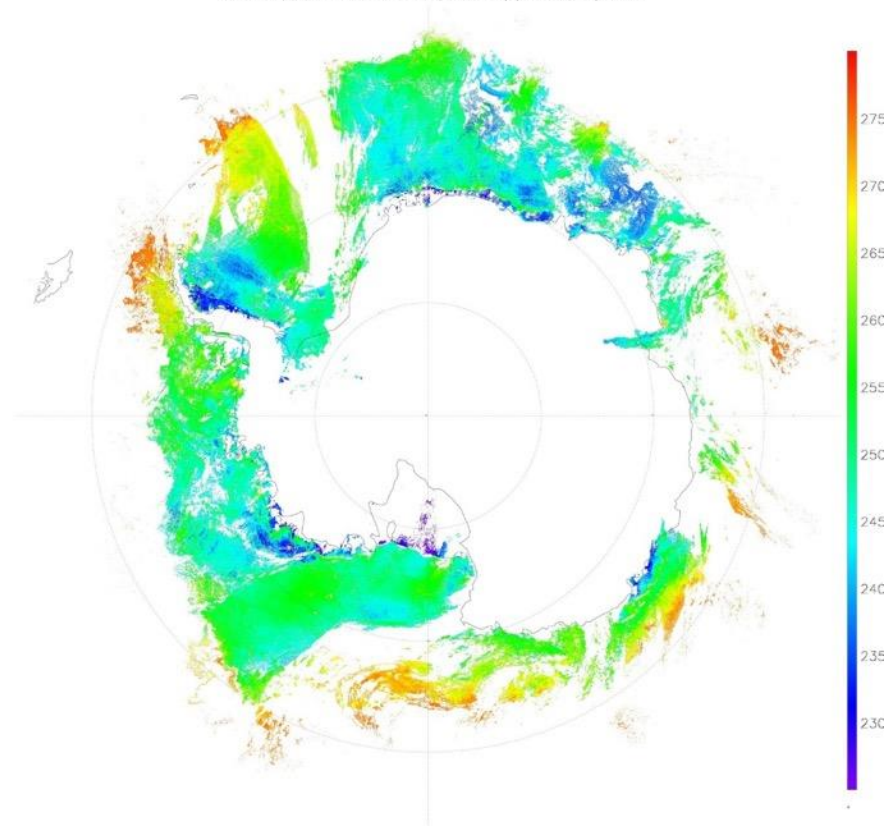


NOAA-20 and S-NPP IST, Antarctic, Aug 18, 2018

N20_Composite Ice Surface Temperature (K) on 08/18/2018

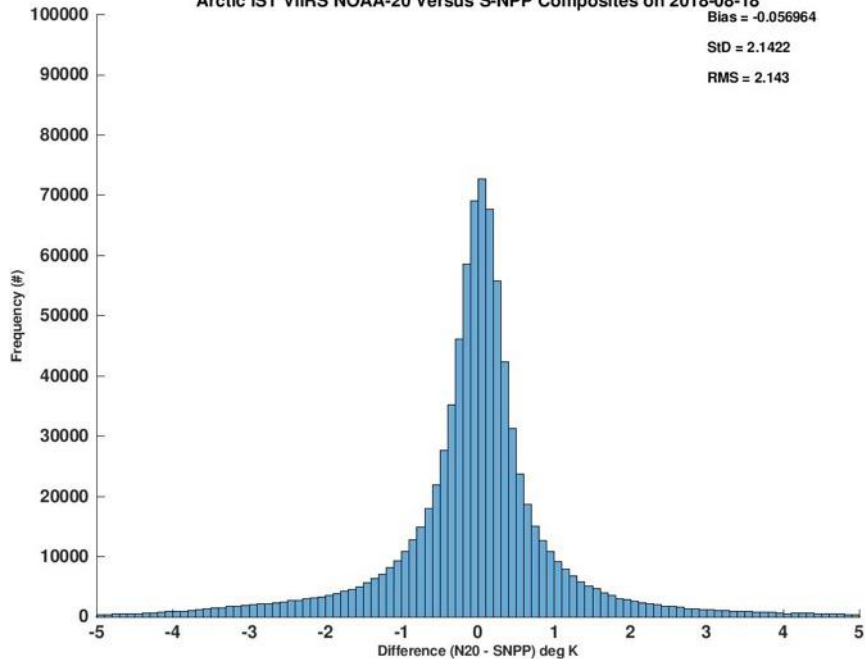


NPP_Composite Ice Surface Temperature (K) on 08/18/2018



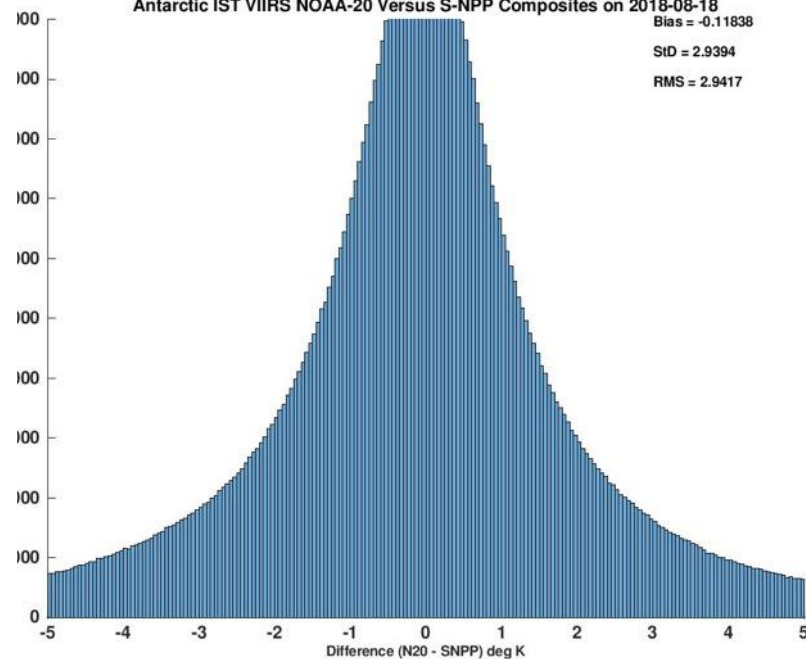
NOAA-20 vs S-NPP IST

Arctic IST VIIRS NOAA-20 Versus S-NPP Composites on 2018-08-18



Bias: -0.057
RMS: 2.143

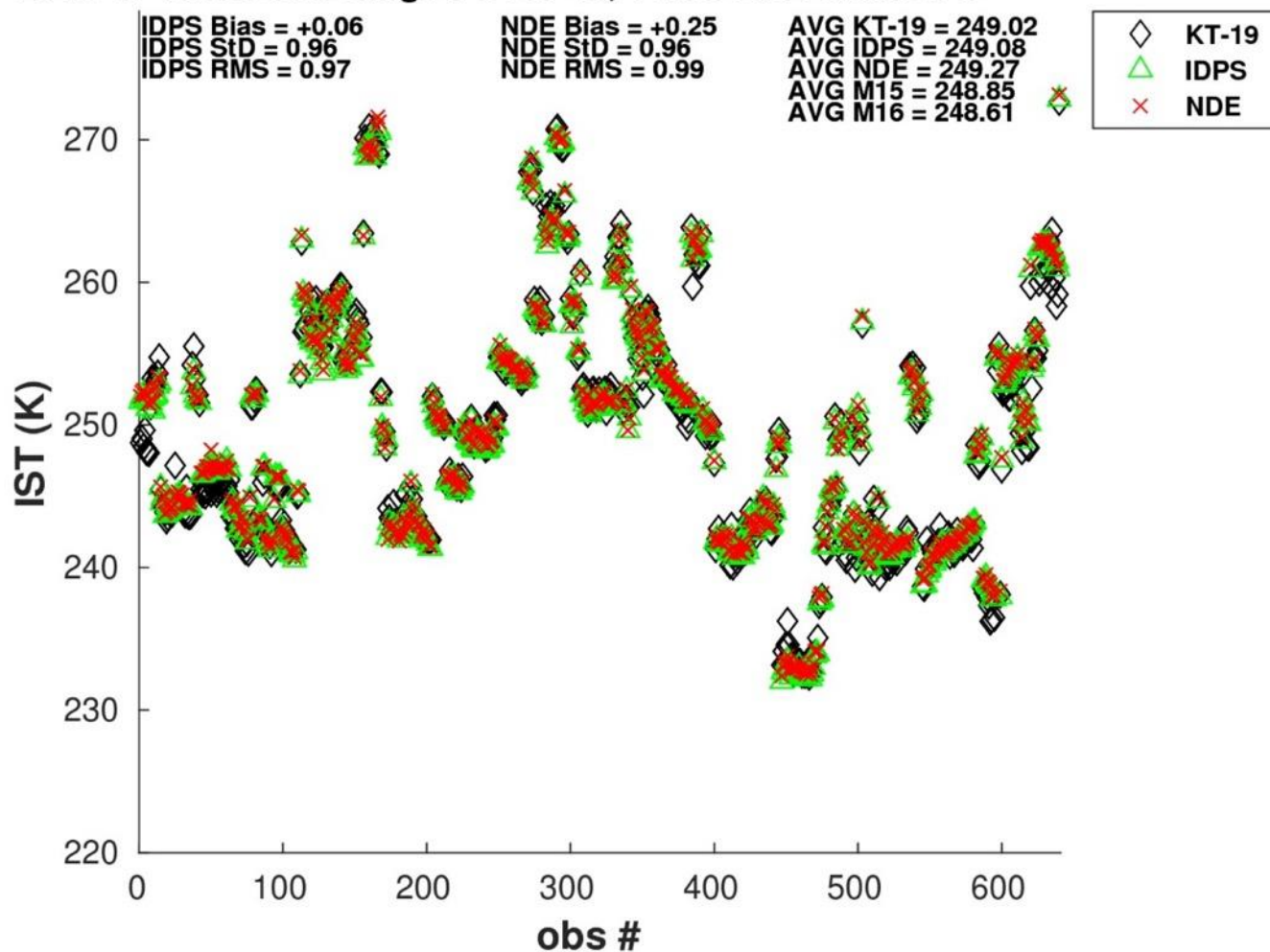
Antarctic IST VIIRS NOAA-20 Versus S-NPP Composites on 2018-08-18



Bias: -0.118
RMS: 2.942

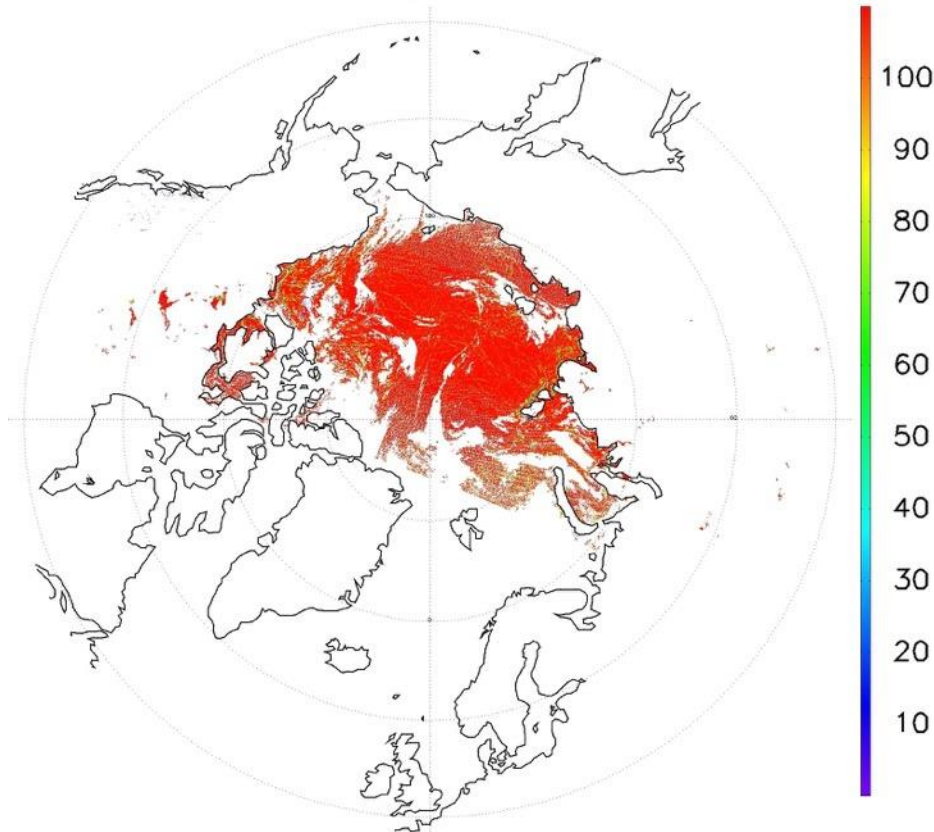
VIIRS IST IceBridge Validation

2013-17 Arctic IceBridge P3 KT-19, VIIRS NDE and IDPS



Ice Concentration

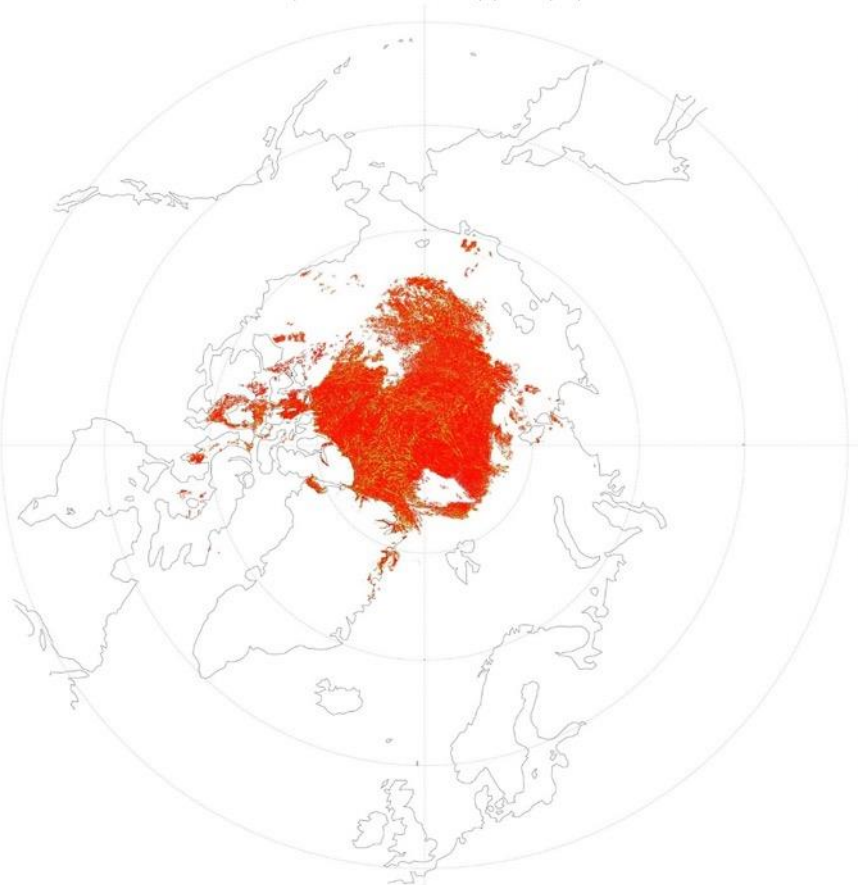
Sea ice concentration is the areal extent of ice, calculated as the fraction of each pixel covered in ice. The concentration of sea ice varies within the ice pack due to deformation, new ice development, melting, and motion.



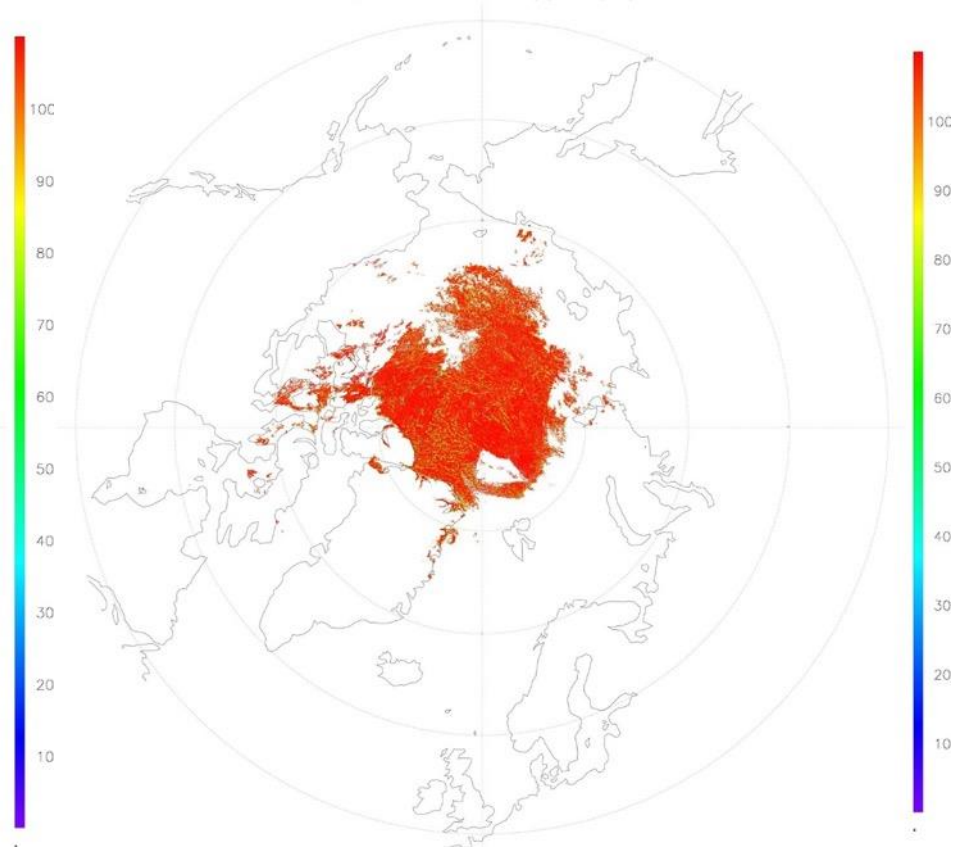
Ice concentration over the Arctic Ocean from VIIRS on February 20, 2015.

NOAA-20 and S-NPP Ice Concentration, Arctic, Aug 1, 2018

N20_Composite Ice Concentration (%) on 08/01/2018

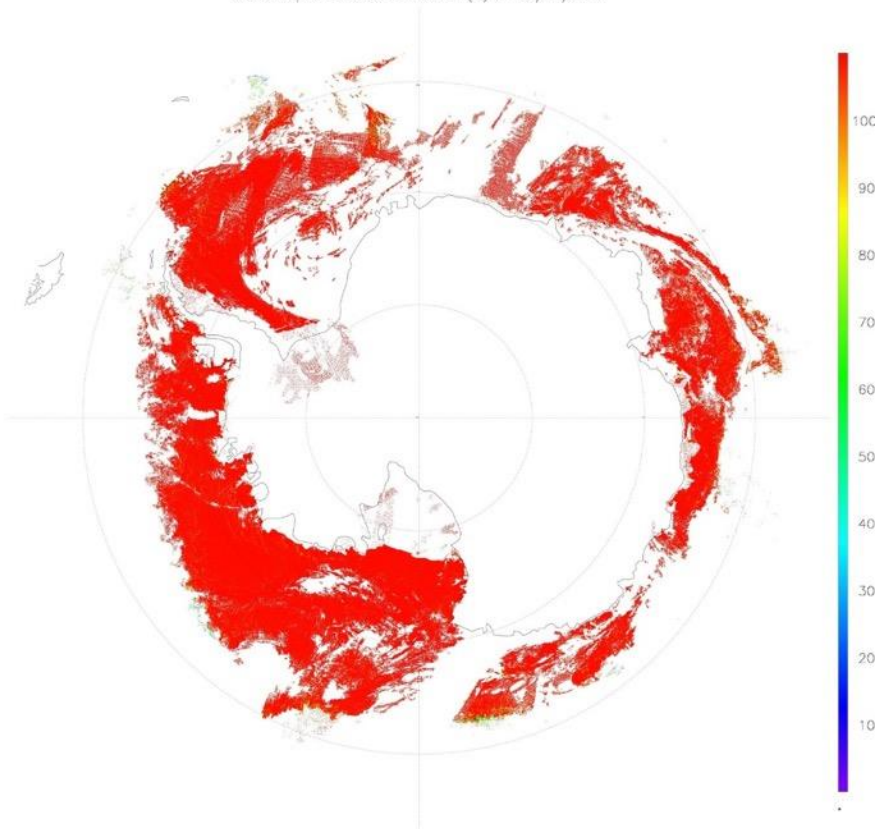


NPP_Composite Ice Concentration (%) on 08/01/2018

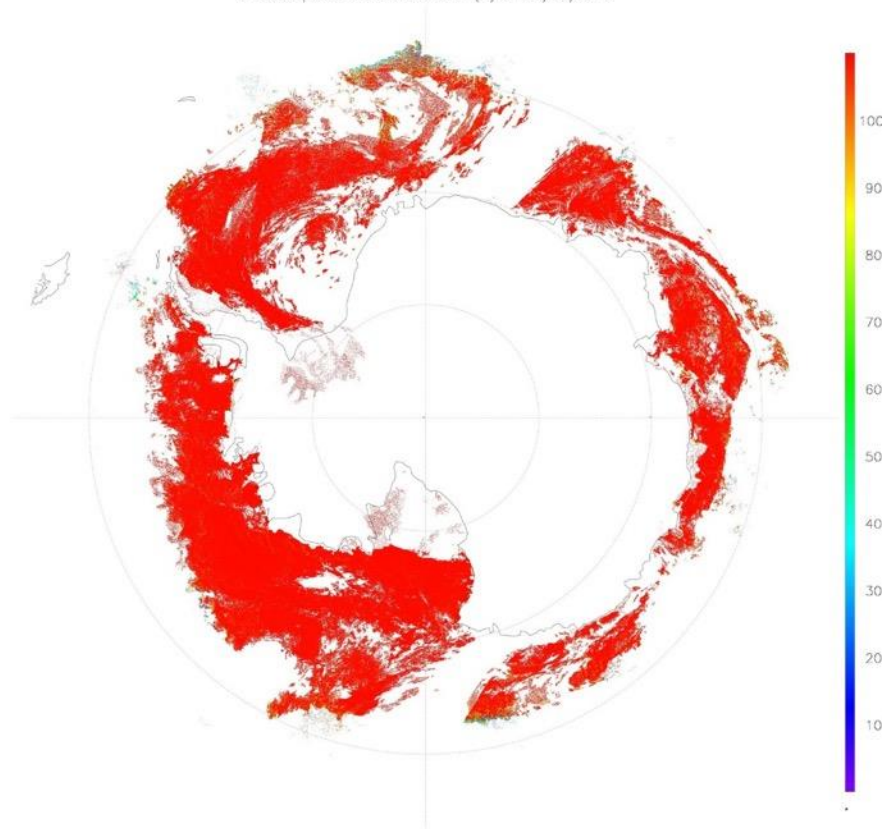


NOAA-20 and NPP Ice Concentration, Antarctic, Aug 1, 2018

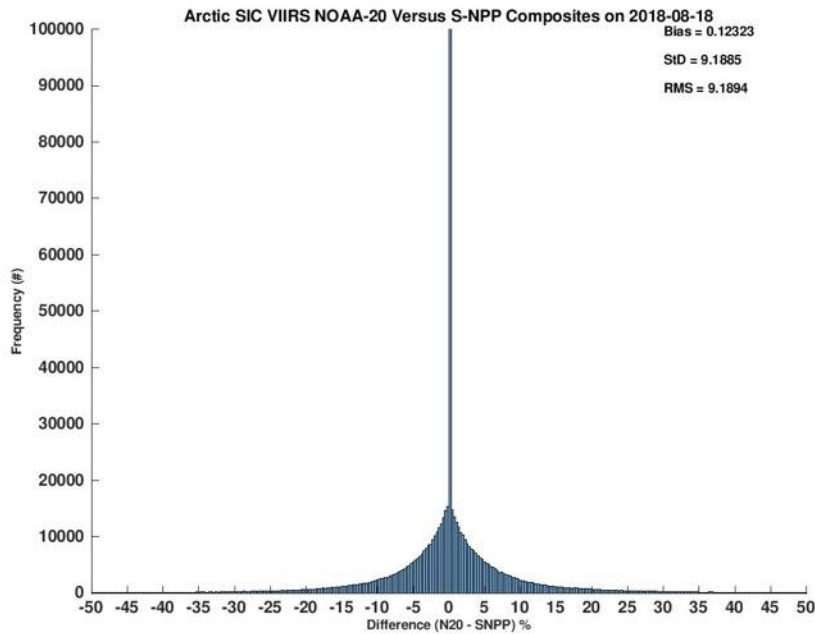
N20_Composite Ice Concentration (%) on 08/01/2018



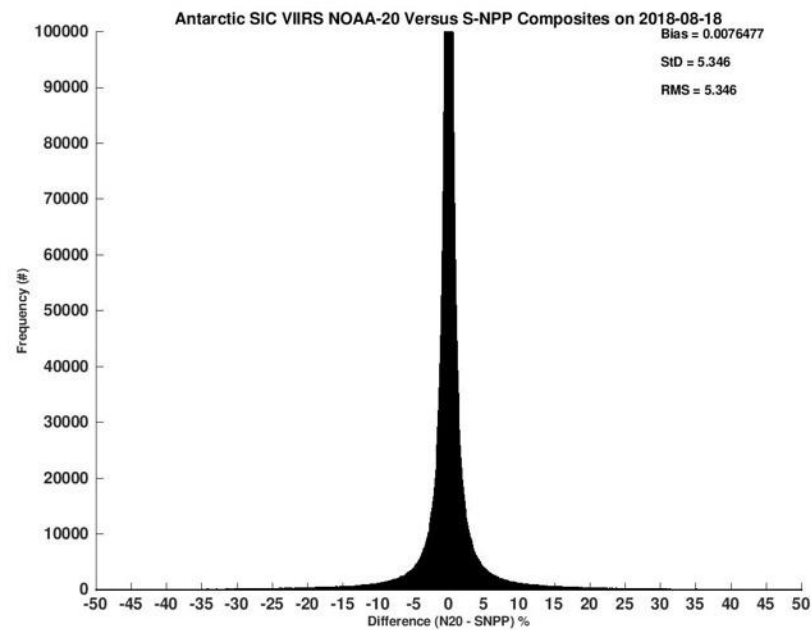
NPP_Composite Ice Concentration (%) on 08/01/2018



NOAA-20 vs S-NPP Ice Concentration



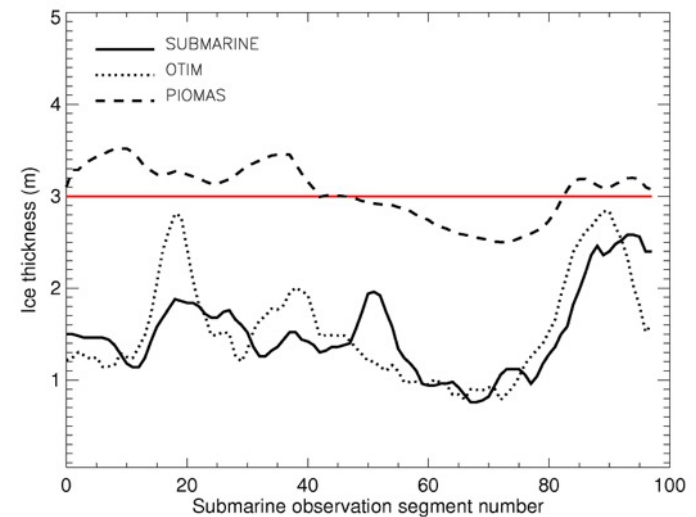
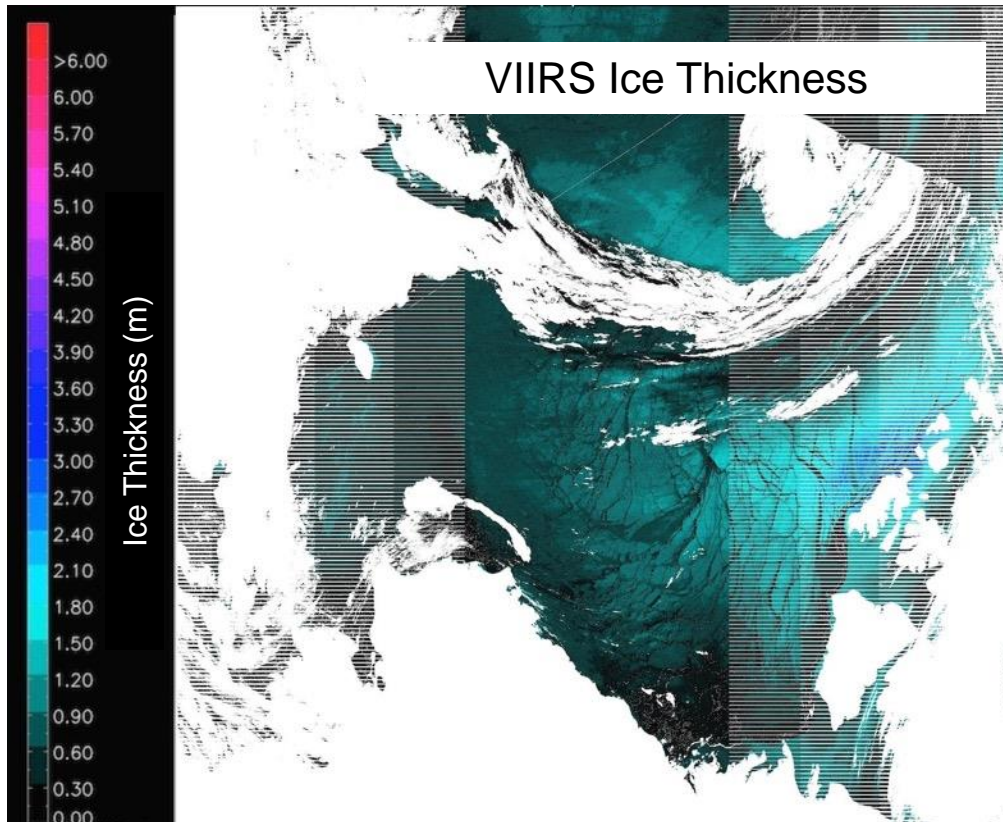
Bias: 0.123
RMS: 9.189



Bias: 0.0076
RMS: 5.346

Sea Ice Thickness

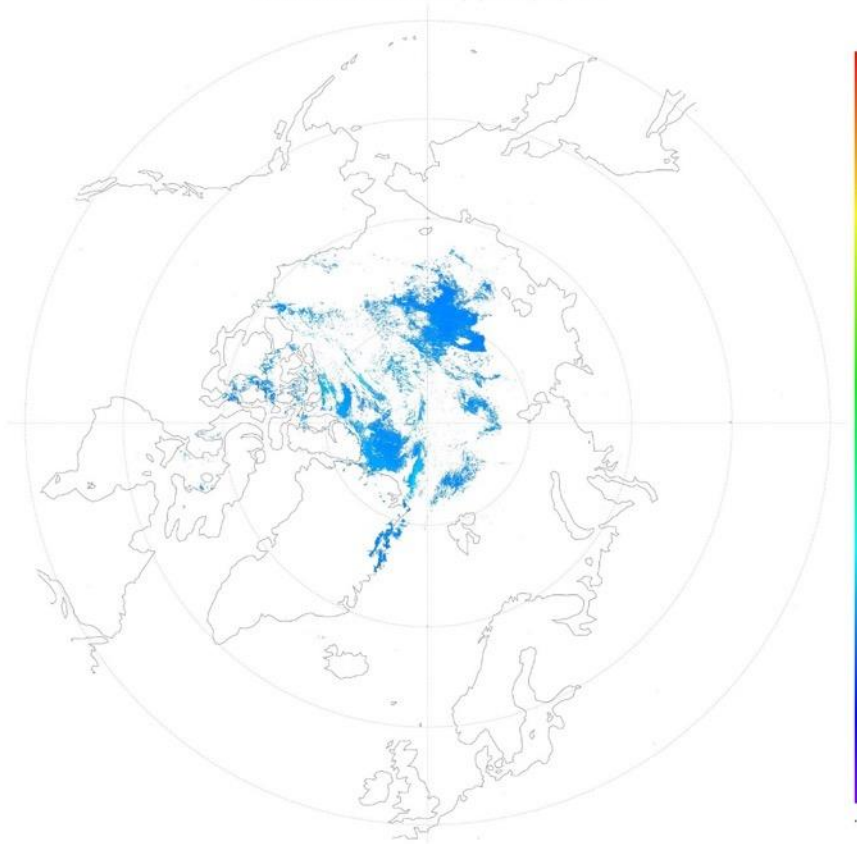
The Sea Ice Characterization EDR is a 3-category product: new/young ice (< 30 cm thick), “other ice”, and ice-free. The Enterprise product provides a continuous ice thickness range from 0 ~ 2.5 m.



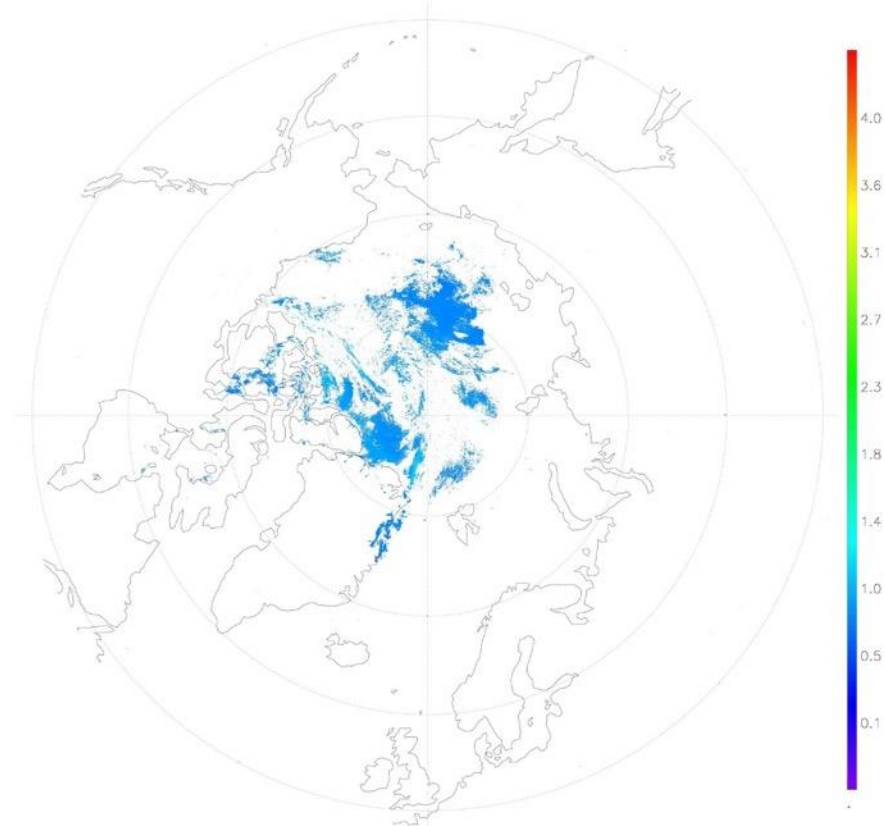
Validation with submarine sonar and modeled ice thicknesses.

NOAA-20 and S-NPP Ice Thickness, Arctic, Aug 18, 2018

N20_Composite Ice Thickness (m) on 08/18/2018

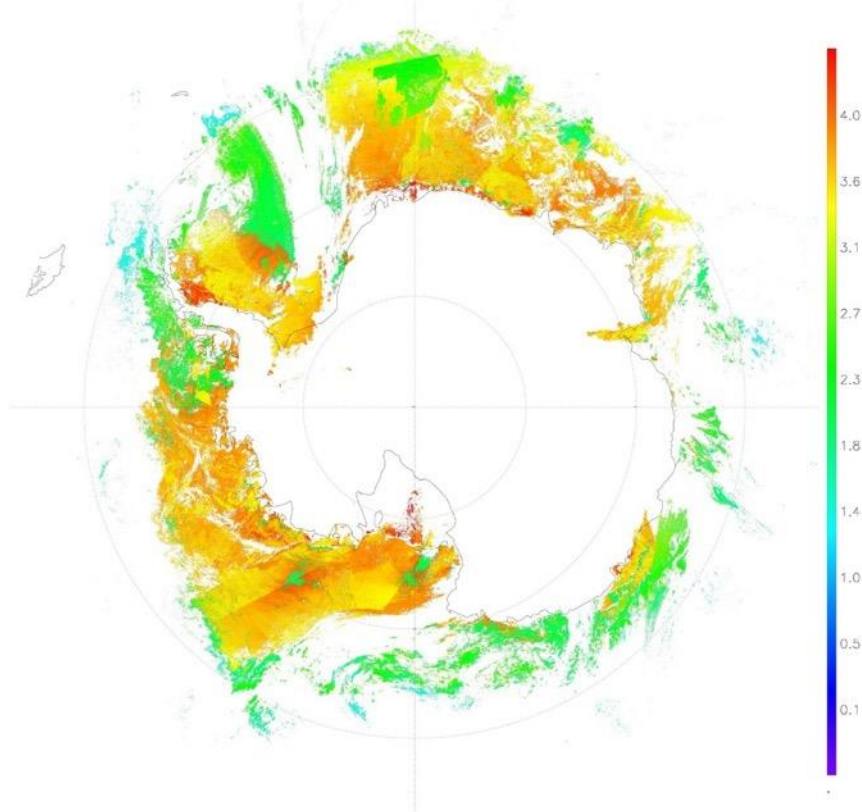


NPP_Composite Ice Thickness (m) on 08/18/2018

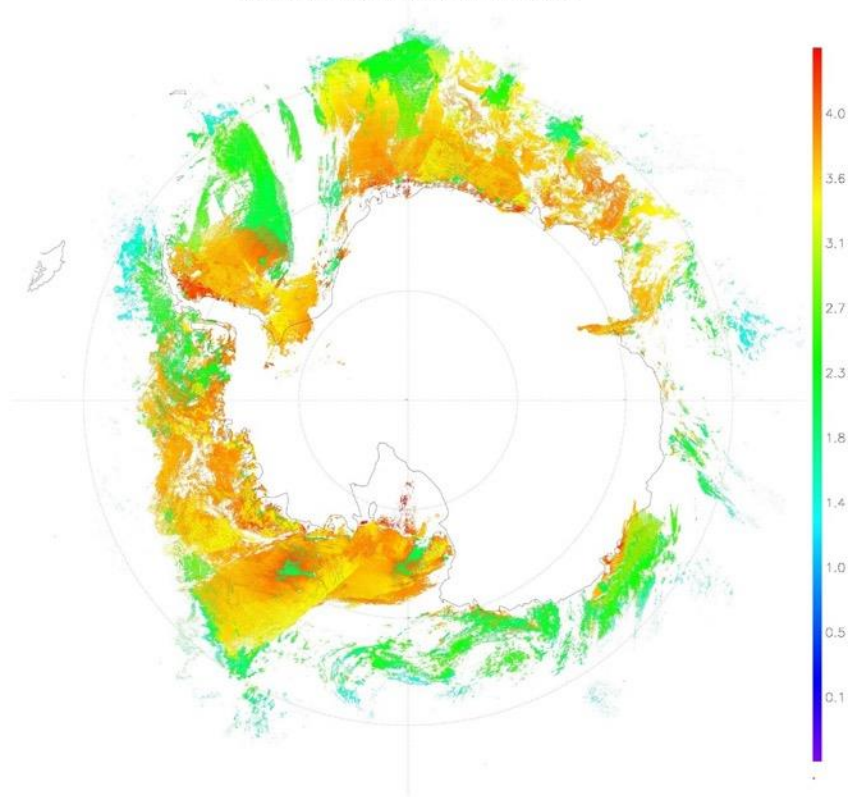


NOAA-20 and S-NPP Ice Thickness, Antarctic, Aug 18, 2018

N20_Composite Ice Thickness (m) on 08/18/2018



NPP_Composite Ice Thickness (m) on 08/18/2018



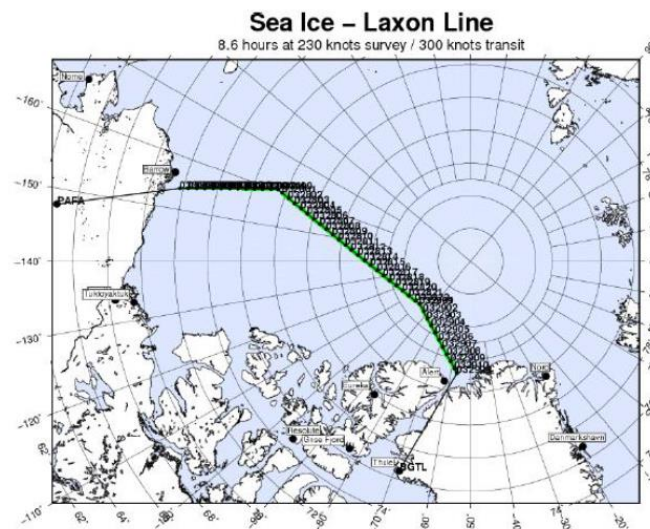
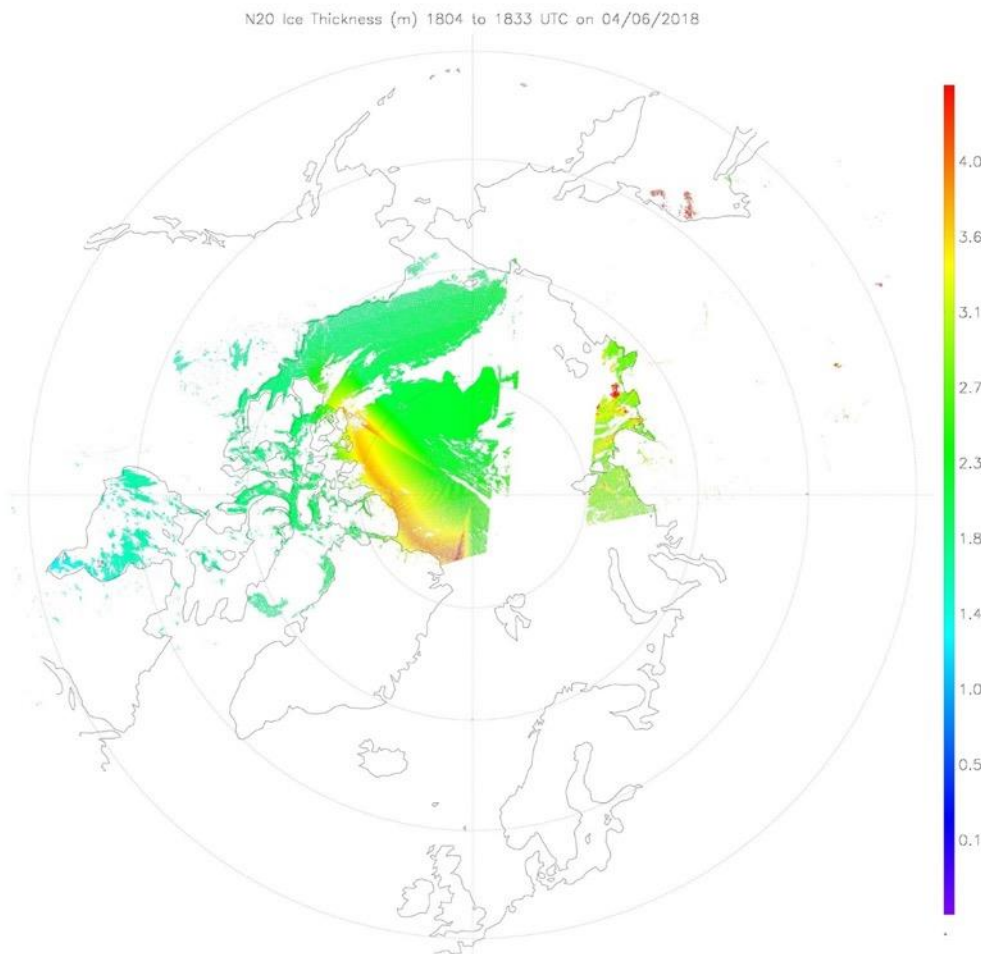
NOAA-20 Ice Thickness vs. IceBridge

April 6, 2018

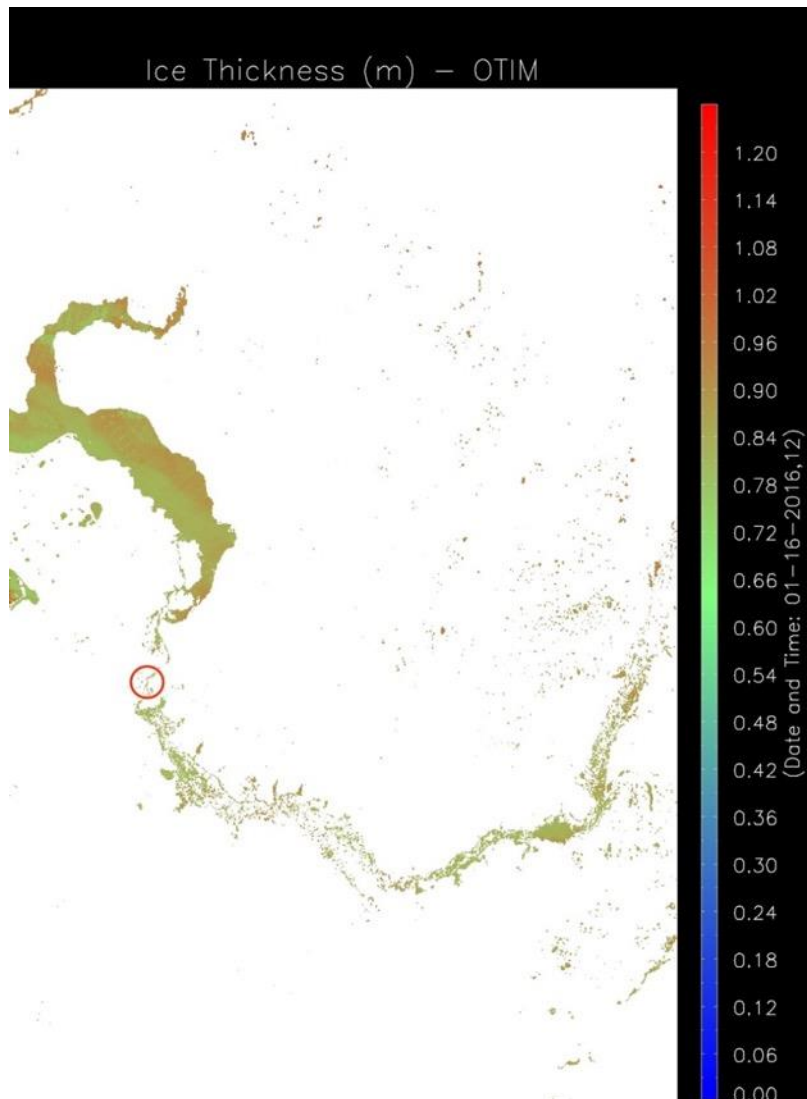
Mean OIB thickness: 3.014m
Mean N-20 thickness: 3.114m

OIB Std Dev: 1.313m
N-20 Std Dev: 0.270m

Correlation: 0.124



VIIRS Sea Ice Thickness on the OB River, Western Siberia

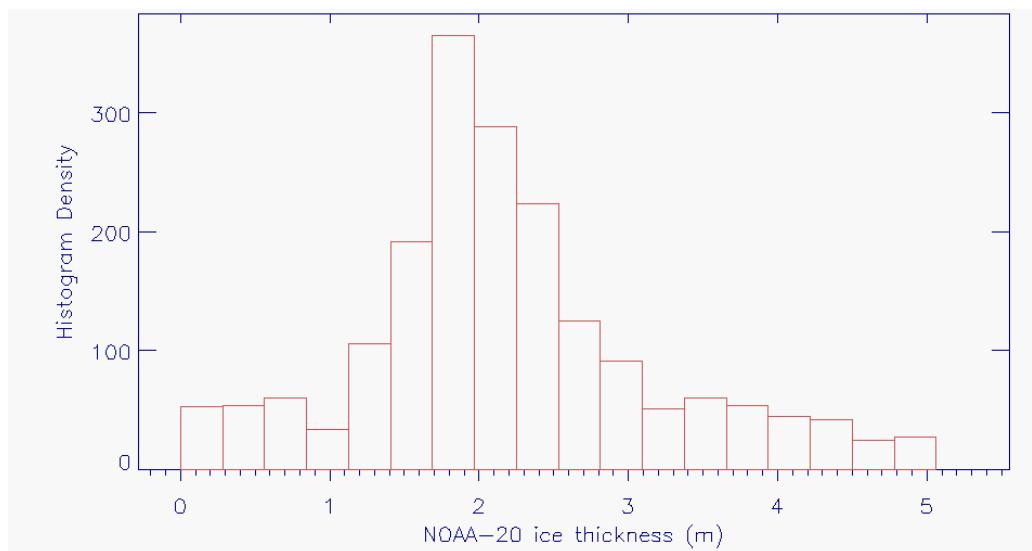


On-ice thickness: 55-60 cm
S-NPP VIIRS thickness: 70 cm



Sea Ice Thickness: NOAA-20 vs CryoSat-2

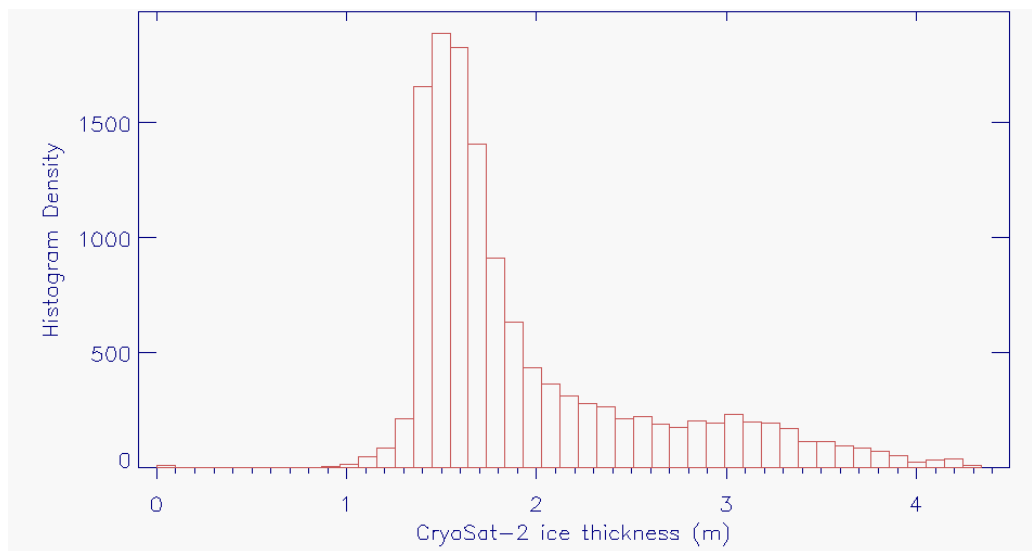
NOAA-20



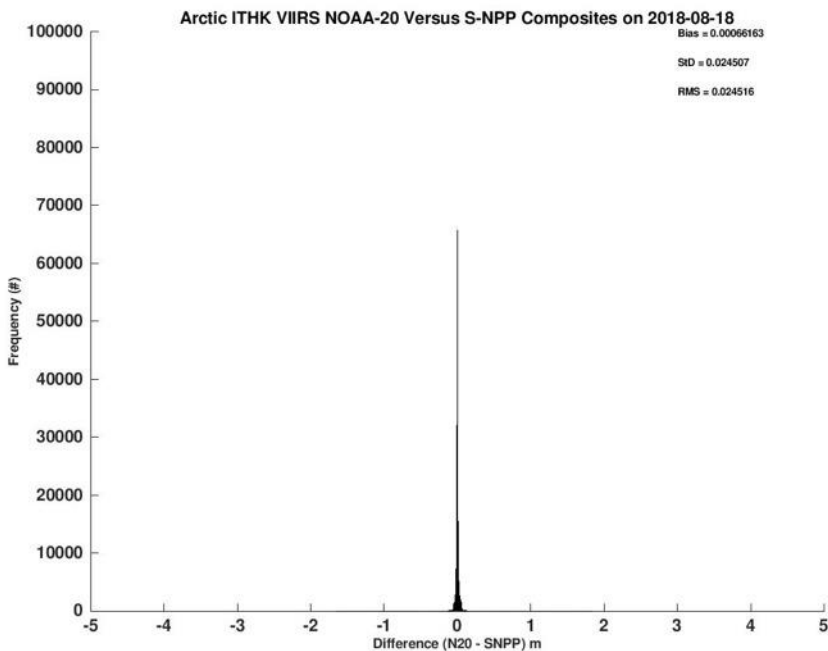
Arctic

April 22-29, 2018

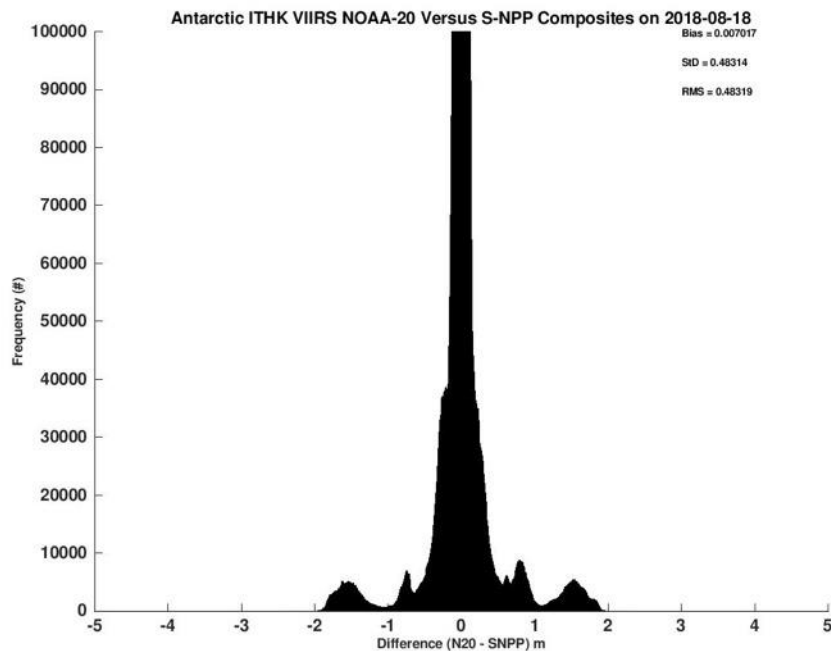
CryoSat-2



NOAA-20 vs S-NPP Ice Thickness

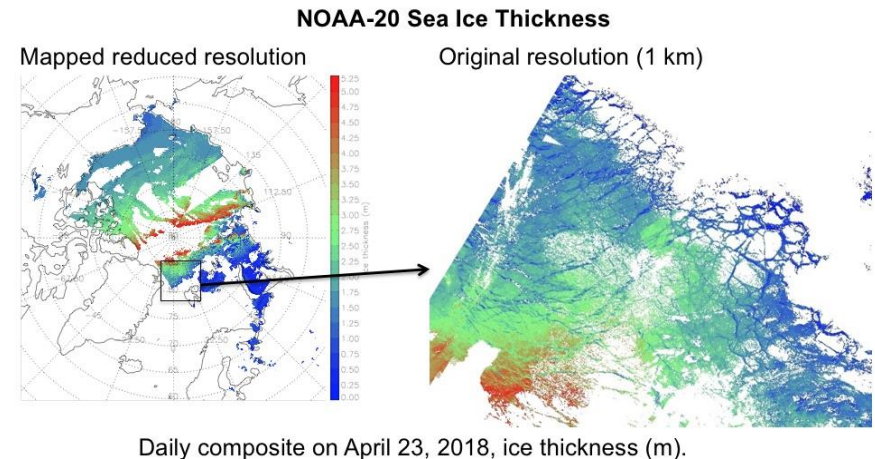


Bias = 0.00066
RMS = 0.0245



Bias = 0.0070
RMS = 0.4832

- The Cryosphere Team participated in the May/June 2018 N20 Calibration/Validation Beta Maturity Review on June 15, 2018.
- The cryosphere products reviewed were binary and fractional snow cover, ice surface temperature, ice concentration, and ice thickness/age.
- The products were accepted as achieving the Beta Maturity level.



Example of the sea ice thickness product that was evaluated in the maturity review.

VIIRS Sea Ice Product Performance Summary

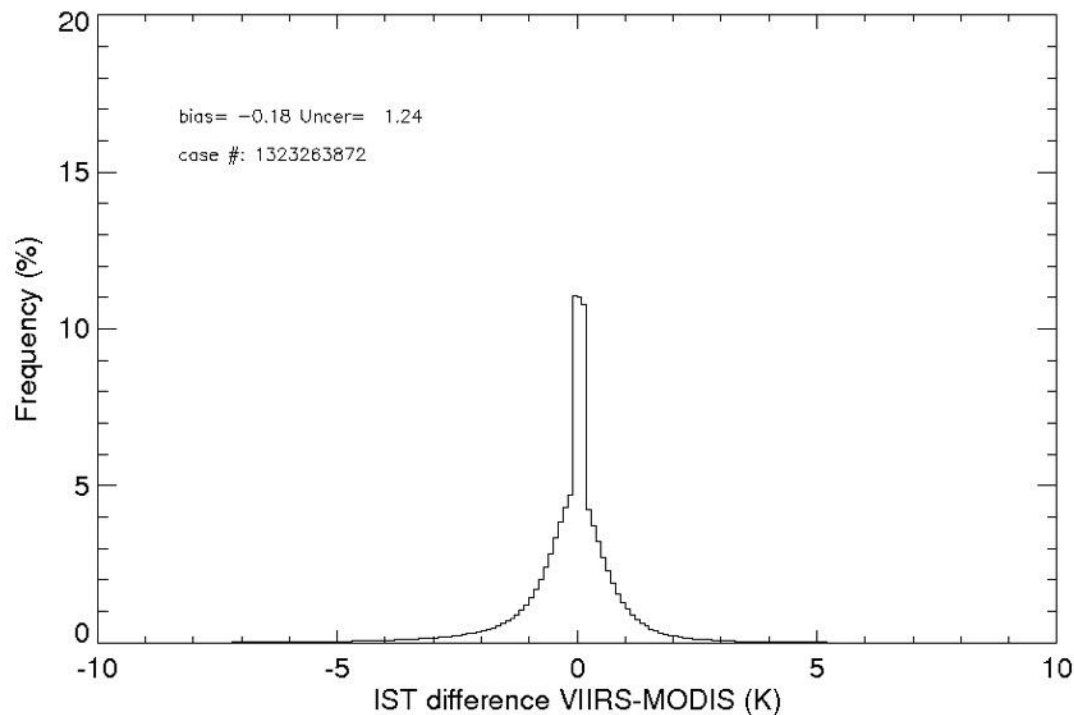
Product	L1RDS APU Thresholds	Performance	Meets Spec?
Ice surface temperature	1 K uncertainty	0.9 K	Y
Ice concentration	10% uncertainty	8.9%	Y
Ice thickness/age	70% correct typing (new/young, other ice); no thickness requirement	90% (first-year/other); 0.5 m precision for thickness	Y





OVERFLOW SLIDES

VIIRS / MODIS IST Inter-comparison



Differences between
NPP VIIRS and
MODIS (Aqua and
Terra) IST in the
Arctic from August
2012 to July 2015.

From: Yinghui Liu, Jeffrey Key,
Mark Tschudi, Richard Dworak,
Robert Mahoney, and Daniel
Baldwin, 2015: Validation of the
Suomi NPP VIIRS Ice Surface
Temperature Environmental
Data Record, *Remote Sens.*
2015, 7, 13507-13527;
doi:10.3390/rs71013507

VIIRS IST Validation Approach

Validation Dataset	Parameter	Spatial Resolution	Spatial Coverage
NASA IceBridge KT-19 IR Surface Temperature	Snow/ice temperature	15 x 15 m	Arctic and Antarctic
MODIS Ice Surface Temperature	Snow/ice temperature	1 km	Arctic and Antarctic
MODIS simultaneous nadir overpass	Snow/ice temperature	0.05 degree longitude by 0.05 degree latitude	Arctic
Arctic drifting buoy	2 m air temperature	Point observations	Arctic
NCEP/NCAR reanalysis	Air temperature at 0.995 sigma level	2.5 x 2.5 degree latitude/longitude	Arctic and Antarctic

Accomplishments / Events:

- In April, 2018, the VIIRS Cryosphere Team performed a near-real-time demonstration of ice products for the Alaska Sea Ice Program (ASIP, NWS).
- Level 1b data and the Enterprise Cloud Mask were obtained from the University of Alaska-Fairbanks direct broadcast system. Ice products were then generated by CIMSS and sent to GINA for display and use by ASIP.
- The ice products include ice concentration, ice thickness, ice surface temperature, and ice motion.
- While some issues were encountered, they were quickly resolved and testing by ASIP was largely successful.

Overall Status:

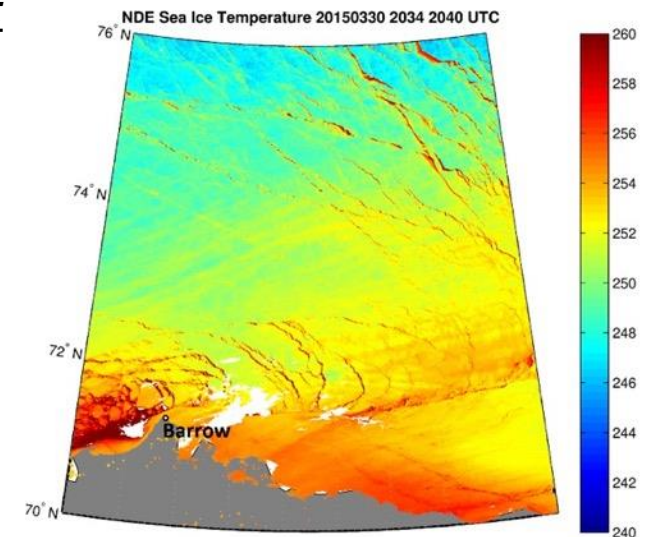
	Green ¹ (Completed)	Blue ² (On-Schedule)	Yellow ³ (Caution)	Red ⁴ (Critical)	Reason for Deviation
Cost / Budget		X			
Technical / Programmatic		X			
Schedule		X			

1. Project has completed.
2. Project is within budget, scope and on schedule.
3. Project has deviated slightly from the plan but should recover.
4. Project has fallen significantly behind schedule, and/or significantly over budget.

Issues/Risks:

None

Highlights:



Ice surface temperature (IST) north of Alaska from VIIRS.

FY18 TTA Milestones	Original Date	Forecast Date	Actual Completion Date	Variance Explanation
J1 post-launch calibration/validation				
Beta Maturity: IST	May-18	May-18		
Beta Maturity: Snow	Jun-18	Jun-18		
Beta Maturity: Sealce	Jul-18	Jul-18		
Provisional Maturity (IST, Snow, and Sealce)	Sep-18	Sep-18		
J1 algorithm adjustments:				
Preliminary DAP to ASSISTT (science team to ASSISTT)	Apr-18	Apr-18		
Preliminary DAP to NDE (ASSISTT to NDE)	Jun-18	Jun-18		
SNPP/J1 algorithm Refinement (Maintenance DAP)				
Improvements to snow and ice algorithms	Sep-18	Sep-18		
Add J1 products to EDR monitoring web	Sep-18	Sep-18		
JPSS EPS algorithm updated DAPs	11/21/17; 02/02/18 (J1 capability)			

Accomplishments / Events:

- NOAA-20 Maturity Review:
 - The Cryosphere Team participated in the May/June 2018 N20 Calibration/Validation Maturity Review on June 15, 2018.
 - The cryosphere products reviewed were binary and fractional snow cover, ice surface temperature, ice concentration, and ice thickness/age.
 - They were accepted as achieving the Beta Maturity level.
- The Provisional Maturity review will be held in a few months, possibly September.

Overall Status:

	Green ¹ (Completed)	Blue ² (On-Schedule)	Yellow ³ (Caution)	Red ⁴ (Critical)	Reason for Deviation
Cost / Budget		X			
Technical / Programmatic		X			
Schedule		X			

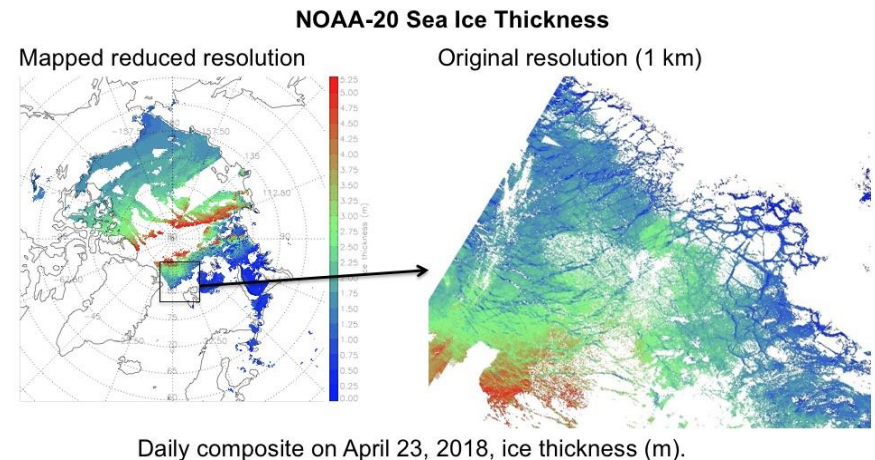
1. Project has completed.
2. Project is within budget, scope and on schedule.
3. Project has deviated slightly from the plan but should recover.
4. Project has fallen significantly behind schedule, and/or significantly over budget.

Issues/Risks:

None

FY18 TTA Milestones	Original Date	Forecast Date	Actual Completion Date	Variance Explanation
J1 post-launch calibration/validation				
Beta Maturity: IST	May-18	May-18	06/15/18	Scheduled 6/15
Beta Maturity: Snow	Jun-18	Jun-18	06/15/18	
Beta Maturity: Sealce	Jul-18	Jul-18	06/15/18	
Provisional Maturity (IST, Snow, and Sealce)	Sep-18	Sep-18		
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Highlights:



Example of the sea ice thickness product that was evaluated in the maturity review.